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(71)(72) Applicant and Inventor: LEE, Kwang, Hwan [KR/KR]; #311 Dongah Building, 14–2, Yeoido-dong, Youngdeungpo-ku, 150-010 Seoul (KR).

(74) Agent: WONN, Seok, Hee; Shinsung International Patent & Law Firm, Haecheon Building, 741–40, Yeoksam 1-dong, Kangnam-ku, 135–081 Seoul (KR).

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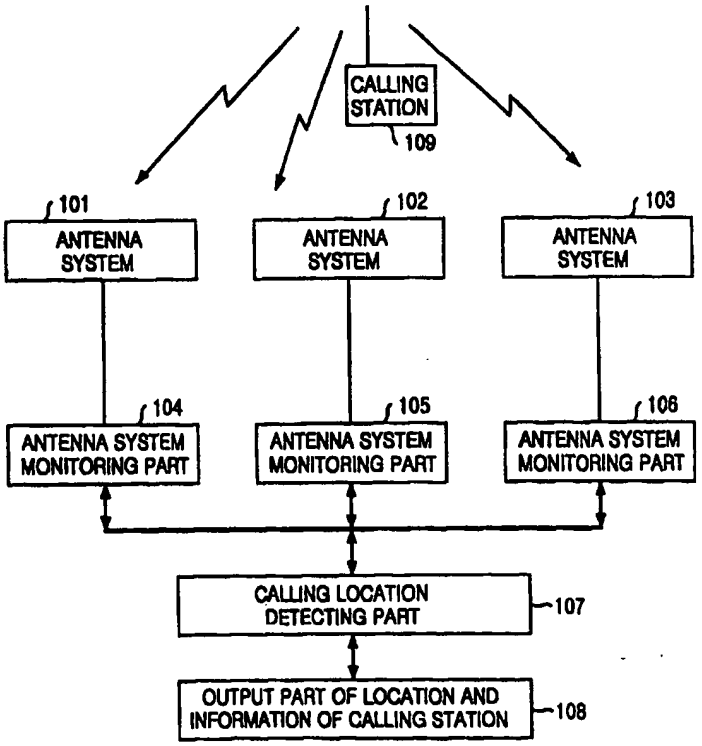
(57) Abstract

Apparatus and method for detecting calling location of radio signal using short pulses from a calling station. The apparatus for detecting calling location of radio signal, comprising: a plurality of antenna systems (101, 102 and 103), each antenna system having a plurality of antennae, for detecting strength of the radio signal and code of calling station (109) if the radio signal of which the strength is larger than a threshold is received; calling location detecting means (107) for detecting the calling location of radio signal based on relation between distances between the antenna systems and receiving angles, after obtaining the receiving angles of the radio signal received at each the antenna system using difference of the radio signal received at a plurality of the antennae and detected; and output means (108) for receiving the calling location of radio signal and the code of the calling station, and for outputting information of the calling station by retrieving subscriber database based on the code of the calling station and the calling location.



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APPARATUS AND METHOD FOR DETECTING CALLING LOCATION OF RADIO SIGNAL USING SHORT PULSE

Description

Technical Field

The present invention relates in general to an apparatus and a method for detecting calling location of radio signal using short pulse from a calling station.

Background Art

There are some methods for detecting calling location of radio signal.

One technique is a method for detecting the direction of calling signal using width of antenna beam of a conventional directional antenna, wherein an angle detector detects the direction of calling signal when the calling signal is detected by the rotation of the directional antenna. In this case, there is a problem that the precision of angle detection decreases even in case where antenna beam is wide. Also, there are some difficulties in precise detection of wide area because of the limited precision of angle detection.

Another is mono pulse measuring method that predicts direction of calling signal using two or more than receiving antenna. Using the mono pulse measuring method, it is possible to obtain preciser angle information than the method using width of antenna beam. However, since mono pulse measuring method has been developed for military technology, facility for implementing mono pulse measuring method costs much and commercial application of parts is not enough to provide commercial service.

Still another is a method using radar. In this case, a signal is emitted from radar, received at a portable calling system and re-emitted from the portable calling system, thereby measuring location of portable calling system using the delay of signal. The

method has problems that the system for implementing the method costs much and the mixture of signals can happen due to multiple reflection of signal.

Disclosure of Invention

It is, therefore, an object of the present invention is to provide an antenna system and a method for detecting strength of radio signal and code information of a calling station from the radio signal received at a given number of antenna systems, the radio signal being short pulse.

Another object of the present invention is to provide an apparatus and a method for detecting location of calling station by using strength of radio signal and code information of a calling station detected from the radio signal received at a given number of antenna systems, the radio signal being short pulse.

In accordance with one aspect of the present invention, there is provided an apparatus for detecting calling location of radio signal, the apparatus comprising: a plurality of antenna systems, each antenna system having a plurality of antennae, for detecting strength of the radio signal and code of calling station if the radio signal of which the strength is larger than a threshold is received; calling location detecting means for detecting the calling location of radio signal based on relation between distances between the antenna systems and receiving angles, after obtaining the receiving angles of the radio signal received at each the antenna system using difference of the radio signal received at a plurality of the antennae and detected; and output means for receiving the calling location of radio signal and the code of the calling station, and for outputting information of the calling station by retrieving subscriber database based on the code of the calling station and the calling location.

In accordance with another aspect of present invention, there is provided an

apparatus for detecting calling location of radio signal, the apparatus comprising: a plurality of antenna systems, each antenna system having a plurality of antennae, for detecting strength of the radio signal and code of calling station if the radio signal of which the strength is larger than a threshold is received; calling location detecting means having neural network which is pre-studied, for detecting the calling location of radio signal based on the strength of the radio signal provided to the neural network, the neural network receiving the strength of the radio signal at an input node thereof and calling location of the radio signal at an output node thereof; and output means for receiving the calling location of radio signal and the code of the calling station, and for outputting information of the calling station by retrieving subscriber database based on the code of the calling station and the calling location.

In accordance with further another aspect of present invention, there is provided a method for detecting calling location of radio signal in an apparatus for detecting calling location of radio signal, the method comprising the steps of: detecting strength of the radio signal received by a plurality of antennae and code of a calling station at each of antenna system if the radio signal transmitted from the calling station is received; measuring receiving angles of the radio signal received at each the antenna system using difference of the radio signal received at a plurality of the antennae in each of the antenna system; detecting the calling location of radio signal based on relation between distances between the antenna systems and the receiving angles; and displaying the calling location of the radio signal and information of the calling station by retrieving map database and subscriber database based on the code of the calling station and the calling location.

In accordance with still another aspect of present invention, there is provided a method for detecting calling location of radio signal in an apparatus for detecting calling

location of radio signal, the method comprising the steps of: allowing a neural network to study relation between input and output thereof by operating the calling station at a location, the input being strength of the radio signal received by each of a plurality of antennae in each antenna system, the output being calling location of the radio signal; detecting strength of the radio signal received by the plurality of antennae and code of a calling station at each of antenna system if the radio signal transmitted from the calling station is received; detecting the calling location by inputting the strength of the radio signal detected at each of the antenna in each the antenna system to the neural network; and displaying the calling location of the radio signal and information of the calling station by retrieving map database and subscriber database based on the code of the calling station and the calling location.

In accordance with still another aspect of present invention, there is provided an antenna system for receiving radio signal, comprising: a plurality of antennae for receiving the radio signal transmitted from the calling station; a plurality of receiving means, each of which demodulates the radio signal from antenna and detects the strength of the radio signal and the code of the calling station; selecting means for selecting one of the plurality of receiving means based on a control signal; analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal received from the receiving means to a digital signal; and signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

In accordance with still another aspect of present invention, there is provided an antenna system for receiving radio signal, comprising: a plurality of antenna for receiving the radio signal transmitted from the calling station; receiving means for demodulating the radio signal and for detecting the strength of the radio signal and the

code of the calling station; switching means for switching the radio signal from the plurality of antenna to the receiving means based on a control signal; analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal to a digital signal; and signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

In accordance with still another aspect of present invention, there is provided a method for receiving radio signal used for an antenna system, comprising the steps of: demodulating the radio signal and detecting the strength of the radio signal and the code of the calling station when the radio signal transmitted from the calling station is received at the a plurality of antenna; converting the strength of the radio signal which is analog signal to a digital signal and detecting the strength of the radio signal; and detecting and transmitting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

Brief Description of Drawings

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig.1 is a block diagram illustrating a calling location detector of radio signal in accordance with the present invention;

Fig. 2 is a diagram illustrating principle of calling location detector in accordance with one embodiment of the present invention;

Fig. 3 is a block diagram of antenna system for receipt of short pulse in accordance with one embodiment of the present invention;

Fig. 4 is a block diagram of antenna system for receipt of short pulse in accordance with another embodiment of the present invention;

Fig. 5 is a flow chart illustrating a method for detecting calling location of radio signal in accordance with one embodiment of the present invention;

Fig. 6 is a diagram illustrating gain according to central angles of antenna, which is used for obtaining receiving angle of radio signal;

Fig. 7 is a flow chart illustrating a method for detecting calling location of radio signal in accordance with another embodiment of the present invention; and

Fig. 8 is a flow chart illustrating a method for receiving short pulse at antenna system in accordance with further another embodiment of the present invention.

Best Mode for Carrying out the Invention

Referring to Fig.1, there is a block diagram of calling location detector of radio signal in accordance with one embodiment of the present invention, which is suitable for simple topography such as level ground and mountains.

A calling location detector of radio signal comprises a calling station 109, a plurality of antenna systems 101, 102, and 103, a plurality of antenna system monitoring parts 104, 105 and 106, a calling location detecting part of radio signal 107, and an output part of location and information of calling location 108.

In this embodiment, each antenna system 101, 102 and 103 comprises six antennae. If the strength of the radio signal is larger than a threshold value, each antenna system detects the strength of radio signal received at each of antennae respectively. Each antenna system 101, 102 and 103 respectively detects and outputs the code of calling station emitting the radio signal of which the strength is largest.

Each antenna system monitoring part 104, 105 and 106 monitors the strength

and the code of radio signal from each antenna system 101, 102 and 103 and outputs the state of the antenna system. The calling location detecting part 107 receives the strength and the code of calling station from antenna system monitoring parts 104, 105 and 106 and obtain receiving angle of radio signal received at each antenna system by using the difference among the strength of the radio signals. Then the calling location detecting part 107 detects calling location of the radio signal by using the receiving angle and distance among the antenna systems 101, 102 and 103.

The output part of location and information of calling station 108 receives the location and the code of calling station from the calling location detecting part 107, retrieves database having information of the calling station using code of calling station and outputs the corresponding information of the calling station. Also, the output part of location and information of calling station 108 represents the location of the calling station on a map.

The strength and the code of the calling stations may be respectively transmitted from each antenna system 101, 102 and 103 to each antenna system monitoring part 104, 105 and 106 by using wire or wireless modem or common communication line.

In another embodiment, only one antenna system monitoring part may be used (not shown in figures), and the strength and code of the calling stations may be transmitted from antenna systems 101, 102 and 103 to the antenna system monitoring part by using wire or wireless multi-modem or common communication line.

In this embodiment, though the number of antenna systems is three and the number of antenna of each antenna system is six, the number of antenna systems and antennae may vary according to the environment and service of application.

In another embodiment, a different calling location detecting part 107 is used. The others are the same as the above-mentioned embodiment, accordingly the detailed

description about the elements except the calling location detecting part 107 will be omitted.

For implementing this embodiment, neural network studies the relation between the strength of radio signal received at each antenna and the calling location of the radio signal. The strength of radio signal is inputted to input an end of the neural network, and the calling location (coordinate) is inputted to an output end of the neural network, thereby obtaining weight function which indicates the relation between input and output.

The calling location detecting part 107 receives the strength and the code of the radio signal from the antenna system monitoring part 104, 105 and 106 and detects the calling location of the radio signal by inputting the strength of the radio signal to the studied neural network. This embodiment is suitable for complicated topography such as metropolitan.

Referring Fig. 2, the operation of the calling location detecting part 107 is illustrated.

The antenna systems 101, 102 and 103 within a range capable of receiving the radio signal detect the location of the calling station when the receiving angle of the radio signal from the calling station 109 is the same with that of each others. That is, the relation between the distance of antenna systems and the receiving angle allows the location of the calling station to be found.

Fig. 3 shows a block diagram of an antenna system for receiving short pulse in accordance with one embodiment of the present invention.

Each antenna system comprises six antennae 301, an antenna switch 302, a receiver 303, an analog/digital (A/D) converter 304 and a signal processing and controlling part 305.

The receiver 303 demodulates the radio signal transmitted from the calling station 109 and received at the antennae 301 and detects the strength of the radio signal and the code of the calling station. The antenna switch 302 receives and selectively switches six radio signals from the antennae 301 according to antenna selecting control signal (3bits) from the signal processing and controlling part 305. The A/D converter 304 receives from the receiver 303 converts the strength of radio signal in analog to digital. The signal processing and controlling part 305 detects and outputs the strength of six radio signals received through the receiver 303 and the A/D converter 304 and the code of the calling station through the receiver 303. At this time, the signal processing and controlling part 305 selects the radio signal having stronger strength than those of the others and outputs the code of the calling station corresponding to the radio signal.

If the calling station generates a short radio signal of which the length is 3 through 100 msec, preferably 65 msec, at every 0.7 through 2 seconds, preferably 1.3 seconds, each antenna system 101, 102 and 103 transmits the information for antenna measurement (e. g., strength of the radio signal, code of calling station, etc.) at every 1.3 seconds.

Each antenna is arranged by 30 degree. The radio signal through one of the six antennae is inputted to the receiver 303. The receiver 303 outputs the strength of radio signal and the code of calling station 109. The antenna switch 302 is controlled by an antenna selecting control signal from the signal processing and controlling part 305. The signal processing and controlling part 305 receives the strength of the radio signal from one of six antennae through the receiver 303 and the A/D converter 304. If the strength of the radio signal is larger than a given value Vref, the signal processing and controlling part 305 determines that the signal is an emergency call, and then subsequently reads again and stores the strength of the signal from first antenna to sixth

antenna and selects one signal of which the strength is largest. Then, the signal processing and controlling part 305 reads the code of the calling station included in the selected signal. When the strength of the radio signals of six antennae and the code of the calling station have been read, the signal processing and controlling part 305 transmits the information to the antenna system monitoring part 106 and the calling location detecting part 107 through serial port and wire or wireless modem.

Fig. 4 shows a block diagram of an antenna system for receiving short pulse in accordance with another embodiment of the present invention.

Each antenna system comprises six antennae 401, six receivers 402, a switch 403, a multichannel analog/digital (A/D) converter 404 and a signal processing and controlling part 405.

Each receiver 402 demodulates the radio signal transmitted from the calling station 109 and received at each antenna 401 and detects the strength of the radio signal and the code of the calling station. The antenna switch 403 receives and selectively switches six radio signals from the receivers 402 according to an antenna selecting control signal (3bits) from the signal processing and controlling part 405. The multichannel A/D converter 404 receives from the receivers 402 converts the strength of radio signal in analog signal to digital signal. The signal processing and controlling part 405 detects and outputs the strength of six radio signals received through the receivers 402 and the A/D converter 404 and code of the calling station through the receiver 402. At this time, the signal processing and controlling part 405 selects the radio signal having stronger strength than that of the others and outputs the code of the calling station corresponding to the radio signal.

If the calling station generates a short radio signal, the length of which is 3 through 60 msec, preferably 20 msec, at every 0.7 through 2 seconds, preferably 1.3

seconds, each antenna system 101, 102 and 103 transmits the information for antenna measurement (e. g., strength of the radio signal, code of calling station, etc.) at every 1.3 seconds. The calling station 109 generating such a short pulse (e. g., 20 msec) allows the consumption of battery to be reduced by 20 to 100 times, thereby being configured as small.

Fig. 5 shows a flow chart illustrating a method for detecting calling location of radio signal in accordance with one embodiment of the present invention. The method in this embodiment is suitable for simple topography such as level ground and mountains.

First, radio signal is received from the calling station 109 at three antenna systems 101 to 103, each antenna system having six antennae at step 501. The strength of the radio signal received at each antenna of antenna systems is respectively detected at step 502. One of the radio signals of which the strength is largest is selected and the code of the calling station is detected from the selected radio signal at step 503. The process monitors the strength of the radio signal and the code of the calling station and reports the state of antenna system to a system operator at step 504.

The receiving angle of the radio signal is measured by using the difference among the strength of the six radio signals received at each antenna system at step 505, the calling location is detected from the relation between the receiving angles and the distance among three antenna systems 101 to 103 at step 506.

Then, the process represents the detected location of calling station on map corresponding thereto, and displays information about subscriber from the code of the calling station by retrieving database storing the information about subscriber at step 507.

Fig. 6 is a diagram illustrating gain according to central angles of antenna, which

is used for obtaining receiving angle of radio signal.

First, operations for compensating receiving angles of antenna will be described.

In this figure, a1 through a6 respectively denote central angle of six antennae and V1 through V6 do gain curve of the antennae. If the receiving direction of the radio signal is between a1 and a2, the radio signal has the maximum strength at antenna 1 or antenna 2. If the strength of the radio signal at the antenna 1 is larger than that at the antenna 2, the receiving angle increases toward a1.

Absolute value of the strength of the radio signal varies according to the distance and geographical environment between the antenna and the calling station. However, the strength of the radio signal does not vary according to the distance between the antenna and the calling station. Accordingly, the receiving angle can be obtained using the strength of the radio signal. However, since the antenna has its characteristics, curves as shown in Fig. 6 can be compensated using the equation 1 as following.

$$\angle T1 = \alpha_{n-1,n}(V_{n-i} - V_n)+\beta_{n-1,n}$$

$$\angle T2 = \alpha_{n-1,n}(V_{n-i} - V_n)+\beta_{n-1,n} \qquad (1)$$

If the difference in the measured strength of the radio signal is applied to the equation (1) when the receiving angles T1 and T2 between antennae n-1 and n are known, values of $\alpha_{n-1,n}$, $\beta_{n-1,n}$ can be obtained. If the curve is obtained, angle of the received radio signal which is an angle between antenna n-1 and antenna n can be obtained by computation. Errors in the values of $\alpha_{n-1,n}$ and $\beta_{n-1,n}$ can be reduced by mean value obtained from a lot of experiments.

Next, operations for obtaining receiving angles of the radio signal will be

described.

If the estimation of the receiving angles can be performed using the difference in the strength of the radio signal received at adjacent antennae by compensating the receiving angles of antenna as mentioned above, an antenna by which the radio signal having largest strength Vn is received is selected. The strength V_{n-1} and V_{n-1} of radio signals received by adjacent antennae are compared with each other. If the strength V_{n-1} is larger than the strength Vn+1, the receiving angle is between a_{n-1} and a_n, the receiving angle $\alpha_{n-1,n}(V_{n-1} - V_n)+\beta_{n-1,n}$ is obtained from $V_{n-1}-V_n$.

Fig. 7 is a flow chart illustrating a method for detecting calling location of radio signal in accordance with another embodiment of the present invention.

Calling stations located at each service area divided by a selected distance, for example, 50m respectively transmit radio signal. The strength of the radio signal transmitted from a location and received at each antenna system 101 to 103 is stored in a memory. Eighteen strength values of the radio signal (six antennae × three antenna system) for one location are stored. Neural network studies the relation between the measured strength of the radio signal and the location of calling station at step 701. At this time, the neural network obtains weight function indicating the relation between input and output by inputting the measured strength values of the radio signal to input node of the neural network and the location of the calling station (coordinate) to its output node. If strength values of the radio signal at each antenna are inputted to the neural network when a calling station generates the radio signal at a certain location, the location of calling station is obtained based on the result of study.

The radio signal is received from the calling station 109 at three antenna systems 101 to 103, each antenna system having six antennae at step 702. The strength of the radio signal received at each antenna of antenna systems is respectively detected

at step 703, the radio signal of which the strength is largest is selected and the code of the calling station is detected from the selected radio signal at step 704. The process monitors the strength of the radio signal and the code of the calling station and reports the state of antenna system to a system operator by monitoring at step 705.

The neural network receives the strength values of the radio signals detected in the three antenna systems and obtains and outputs the calling location of the radio signal based on the studied weight function at step 706.

Then, the process represents the detected location of calling station on map corresponding thereto and display information about subscriber by retrieving database storing the information about subscriber from the code of the calling station at step 707.

When the calling station generating and transmitting radio signal moves, the strength of the radio signal received at the antenna systems widely varies, thereby resulting in error of output location. To reduce this shortage, in the present invention, mean value of a lot of the strength of the radio signal is inputted to the neural network.

The method using the neural network as mentioned above is suitable for complicated topography such as metropolitan. That is, this method is useful for detecting the calling location where wave environment is so complicated that it can not be used the method using the receiving angle of the radio signal. Configuration and operation of the above neural network is similar to those of a general neural network. The (eighteen) strength values of the received radio signal are provided to the input end of the neural network and (two) coordinates of the calling location are outputted at the output end.

Fig. 8 is a flow chart illustrating a method for receiving short pulse at antenna system in accordance with further another embodiment of the present invention.

First, if the radio signal transmitted from the calling station 109 are received by

six receiving antennae at step 801, the radio signal received at each of six antennae is demodulated in each of six receiver 402 and the strength of the radio signal and code of the calling station are respectively detected at step 802.

One of six receivers 402 is selected in response to (3bits) code selecting control signal at step 803. Analog strength of the radio signal and code of the calling station are converted to digital signals at step 805, and the digital strength of the radio signal is outputted at step 805.

Then, the process continues at step 806 determining whether all receivers have been selected in serial. If they have been selected, one of radio signals of which the strength is largest is selected and the code of the calling station thereof is detected at step 808. The detected code of the calling station and six strength values of the radio signal are transmitted at step 809.

In the present invention, the antenna system is embodied using the code selecting switch which selects one of six receivers respectively coupled to six receiving antennae. The antenna system detects 20 msec short radio pulses generated at every 1.3 seconds. The calling station 109 generating such a short pulse (e. g., 20 msec) allows the consumption of battery to be reduced by 20 to 100 times, thereby being configured as small.

Sequential selection of six receiver by the code selecting switch allows noise generated in switching operation and receiving time to be reduced.

The present invention can performs precise location detecting service in wide area. Therefore, the method for detecting calling location of the present invention is used for emergency call service, finding a missing child, etc.

Although the preferred embodiments of the invention have been disclosed for illustrative purpose, those skilled in the art will appreciate that various modification,

addition and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in accompanying claims.

Claims

1. An apparatus for detecting a calling location of a radio signal, the apparatus comprising:

a plurality of antenna systems, each antenna system having a plurality of antennae, for detecting strength of the radio signal and a code of the calling station if the radio signal of which the strength is larger than a threshold is received;

calling location detecting means for detecting the calling location of radio signal based on relation between distances between said antenna systems and receiving angles, after obtaining the receiving angles of the radio signal received at each said antenna system using difference of the radio signal received at a plurality of said antennae and detected; and

output means for receiving the calling location of radio signal and the code of the calling station, and for outputting information of the calling station by retrieving subscriber database based on the code of the calling station and the calling location.

2. The apparatus as claimed in claim 1, further comprising a plurality of monitoring means for respectively outputting state of said plurality of antenna system by monitoring the strength of the radio signal and the code of the calling station.

3. The apparatus as claimed in claim 2, wherein the number of said monitoring means is the same with that of said antenna system, and wherein each of said antenna system communicates the strength of the radio signal and the code of the calling station with each of said monitoring means through modem or communication line.

4. The apparatus as claimed in claim 2, wherein said monitoring means receives the strength of the radio signal and the code of the calling station transmitted from said plurality of antenna systems through multi-modem and outputs state of said antenna systems.

5. The apparatus as claimed in claim 1, wherein each of said antenna system comprises:

a plurality of antenna for receiving the radio signal transmitted from the calling station;

receiving means for demodulating the radio signal and for detecting the strength of the radio signal and the code of the calling station;

switching means for switching the radio signal from said plurality of antenna to said receiving means based on a control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

6. The apparatus as claimed in claim 5, wherein said signal processing and controlling means detects and transmits a plurality of the radio signals received through said receiving means and said A/D converting means based on the control signal and the code of the calling station.

7. The apparatus as claimed in claim 6, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and

detects code of the calling station included in the selected radio signal.

8. The apparatus as claimed in claim 5, wherein said switching means consecutively selects one of said plurality of antennae based on the control signal from said signal processing and controlling means.

9. The apparatus as claimed in claim 1, wherein said antenna system comprises:

a plurality of antennae for receiving the radio signal transmitted from the calling station;

a plurality of receiving means, each of which demodulates the radio signal from antenna and detects the strength of the radio signal and the code of the calling station;

selecting means for selecting one of said plurality of receiving means based on a control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal received from said receiving means to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

10. The apparatus as claimed in claim 9, wherein said signal processing and controlling means detects and transmits a plurality of the radio signals received through said receiving means and said A/D converting means based on the control signal and the code of the calling station.

11. The apparatus as claimed in claim 10, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and

detects code of the calling station included in the selected radio signal.

12. The apparatus as claimed in claim 9, wherein said selecting means consecutively selects one of said plurality of receiving antennae based on the control signal from said signal processing and controlling means.

13. An apparatus for detecting calling location of radio signal, the apparatus comprising:

a plurality of antenna systems, each antenna system having a plurality of antennae, for detecting strength of the radio signal and code of calling station if the radio signal of which the strength is larger than a threshold is received;

calling location detecting means having neural network which is pre-studied, for detecting the calling location of radio signal based on the strength of the radio signal provided to the neural network, the neural network receiving the strength of the radio signal at an input node thereof and calling location of the radio signal at an output node thereof; and

output means for receiving the calling location of radio signal and the code of the calling station, and for outputting information of the calling station by retrieving subscriber database based on the code of the calling station and the calling location.

14. The apparatus as claimed in claim 13, further comprising a plurality of monitoring means for respectively outputting state of said plurality of antenna system by monitoring the strength of the radio signal and the code of the calling station.

15. The apparatus as claimed in claim 14, wherein the number of said

monitoring means is the same with that of said antenna system, and wherein each of said antenna system communicates the strength of the radio signal and the code of the calling station with each of said monitoring means through modem or communication line.

16. The apparatus as claimed in claim 14, wherein said monitoring means receives the strength of the radio signal and the code of the calling station transmitted from said plurality of antenna systems through multi-modem and outputs state of said antenna systems.

17. The apparatus as claimed in claim 13, wherein each of said antenna system comprises:

a plurality of antennae for receiving the radio signal transmitted from the calling station;

receiving means for demodulating the radio signal and for detecting the strength of the radio signal and the code of the calling station;

switching means for switching the radio signal from said plurality of antenna to said receiving means based on a control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

18. The apparatus as claimed in claim 17, wherein said signal processing and controlling means detects and transmits a plurality of the radio signals received through

said receiving means and said A/D converting means based on the control signal and the code of the calling station.

19. The apparatus as claimed in claim 18, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and detects code of the calling station included in the selected radio signal.

20. The apparatus as claimed in claim 17, wherein said switching means consecutively selects one of said plurality of antennae based on the control signal from said signal processing and controlling means.

21. The apparatus as claimed in claim 13, wherein said antenna system comprises:

a plurality of antennae for receiving the radio signal transmitted from the calling station;

a plurality of receiving means, each of which demodulates the radio signal from antenna and detects the strength of the radio signal and the code of the calling station;

selecting means for selecting one of said plurality of receiving means based on a control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal received from said receiving means to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

22. The apparatus as claimed in claim 21, wherein said signal processing and

controlling means detects and transmits a plurality of the radio signals received through said receiving means and said A/D converting means based on the control signal and the code of the calling station.

23. The apparatus as claimed in claim 22, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and detects code of the calling station included in the selected radio signal.

24. The apparatus as claimed in claim 21, wherein said selecting means consecutively selects one of said plurality of receiving antennae based on the control signal from said signal processing and controlling means.

25. A method for detecting calling location of radio signal in an apparatus for detecting calling location of radio signal, said method comprising the steps of:

detecting strength of the radio signal received by a plurality of antennae and code of a calling station at each of antenna system if the radio signal transmitted from the calling station is received;

measuring receiving angles of the radio signal received at each said antenna system using difference of the radio signal received at a plurality of said antennae in each of the antenna system;

detecting the calling location of radio signal based on relation between distances between said antenna systems and the receiving angles; and

displaying the calling location of the radio signal and information of the calling station by retrieving map database and subscriber database based on the code of the calling station and the calling location.

26. The method as claimed in claim 25, further comprising the step of respectively outputting state of said plurality of antenna system by monitoring the strength of the radio signal and the code of the calling station.

27. The method as claimed in claim 25, wherein the step of detecting further comprises the steps of:

demodulating the radio signal and detecting the strength of the radio signal and the code of the calling station when the radio signal transmitted from the calling station is received at said a plurality of antenna;

converting the strength of the radio signal which is analog signal to a digital signal and detecting the strength of the radio signal; and

detecting and transmitting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

28. A method for detecting calling location of radio signal in an apparatus for detecting calling location of radio signal, said method comprising the steps of:

allowing a neural network to study relation between input and output thereof by operating the calling station at a location, the input being strength of the radio signal received by each of a plurality of antennae in each antenna system, the output being calling location of the radio signal;

detecting strength of the radio signal received by said a plurality of antennae and code of a calling station at each of antenna system if the radio signal transmitted from the calling station is received;

detecting the calling location by inputting the strength of the radio signal

detected at each of said antenna in each said antenna system to the neural network; and

displaying the calling location of the radio signal and information of the calling station by retrieving map database and subscriber database based on the code of the calling station and the calling location.

29. The method as claimed in claim 28, further comprising the step of respectively outputting state of said plurality of antenna system by monitoring the strength of the radio signal and the code of the calling station.

30. The method as claimed in claim 28, wherein the step of detecting further comprises the steps of:

demodulating the radio signal and detecting the strength of the radio signal and the code of the calling station when the radio signal transmitted from the calling station is received at said a plurality of antenna;

converting the strength of the radio signal which is analog signal to a digital signal and detecting the strength of the radio signal; and

detecting and transmitting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

31. An antenna system for receiving radio signal, comprising:

a plurality of antennae for receiving the radio signal transmitted from the calling station;

a plurality of receiving means, each of which demodulates the radio signal from antenna and detects the strength of the radio signal and the code of the calling station;

selecting means for selecting one of said plurality of receiving means based on a

control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal received from said receiving means to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

32. The antenna system as claimed in claim 31, wherein said signal processing and controlling means detects and transmits a plurality of the radio signals received through said receiving means and said A/D converting means based on the control signal and the code of the calling station.

33. The antenna system as claimed in claim 32, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and detects code of the calling station included in the selected radio signal.

34. The antenna system as claimed in claim 31, wherein said selecting means consecutively selects one of said plurality of receiving antennae based on the control signal from said signal processing and controlling means.

35. An antenna system for receiving radio signal, comprising:

a plurality of antenna for receiving the radio signal transmitted from the calling station;

receiving means for demodulating the radio signal and for detecting the strength of the radio signal and the code of the calling station;

switching means for switching the radio signal from said plurality of antenna to

said receiving means based on a control signal;

analog/digital (A/D) converting means for converting the strength of the radio signal which is analog signal to a digital signal; and

signal processing and controlling means for detecting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

36. The antenna system as claimed in claim 35, wherein said signal processing and controlling means detects and transmits a plurality of the radio signals received through said receiving means and said A/D converting means based on the control signal and the code of the calling station.

37. The antenna system as claimed in claim 36, wherein said signal processing and controlling means selects one of the radio signals of which strength is largest and detects code of the calling station included in the selected radio signal.

38. The antenna system as claimed in claim 35, wherein said selecting means consecutively selects one of said plurality of receiving antennae based on the control signal from said signal processing and controlling means.

39. A method for receiving radio signal used for an antenna system, comprising the steps of:

demodulating the radio signal and detecting the strength of the radio signal and the code of the calling station when the radio signal transmitted from the calling station is received at said a plurality of antenna;

converting the strength of the radio signal which is analog signal to a digital

signal and detecting the strength of the radio signal; and

detecting and transmitting a plurality of the strength of the radio signal and the code of the calling station based on the control signal.

FIG. 1

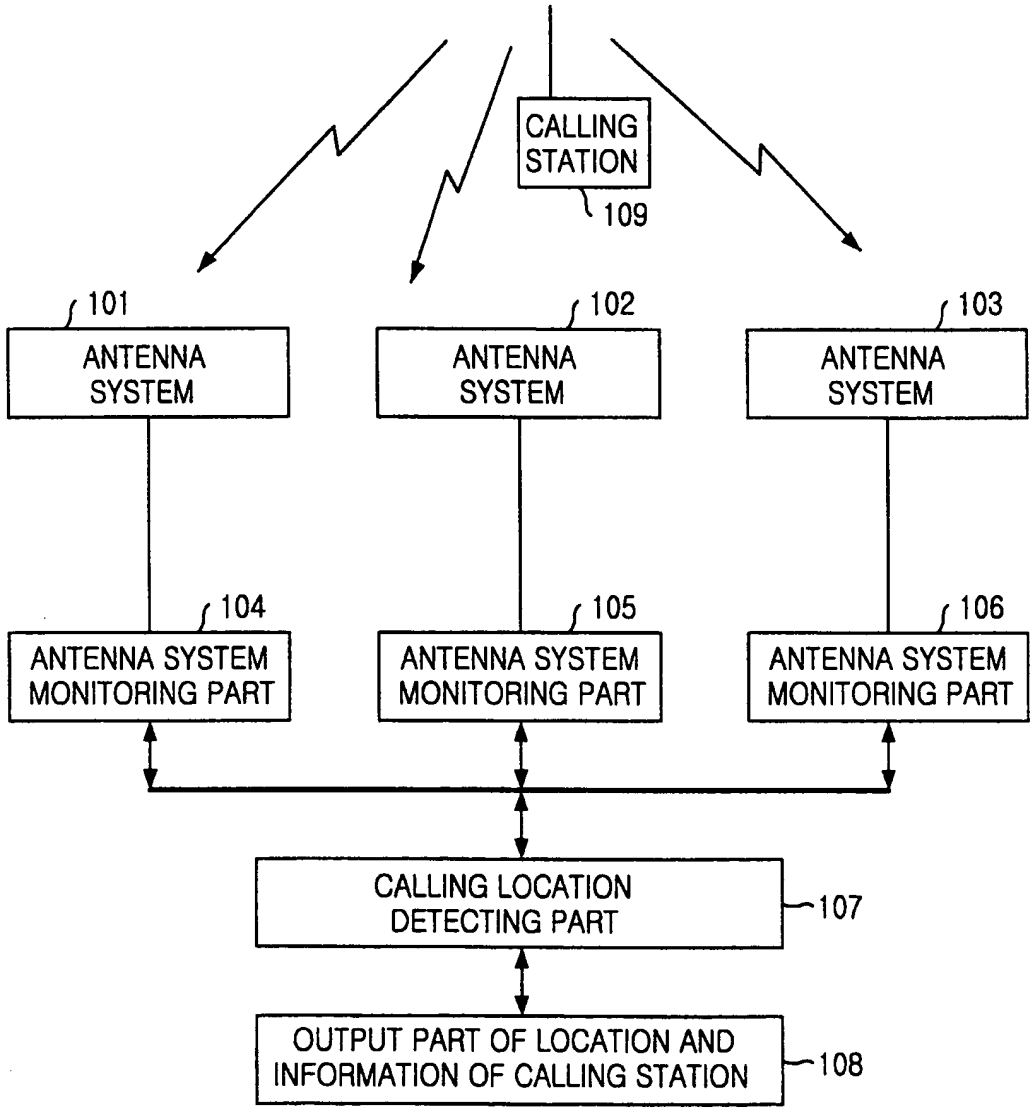

CALLING STATION
109
101
ANTENNA SYSTEM
102
ANTENNA SYSTEM
103
ANTENNA SYSTEM
104
ANTENNA SYSTEM MONITORING PART
105
ANTENNA SYSTEM MONITORING PART
106
ANTENNA SYSTEM MONITORING PART
CALLING LOCATION DETECTING PART
107
OUTPUT PART OF LOCATION AND INFORMATION OF CALLING STATION
108

FIG. 2

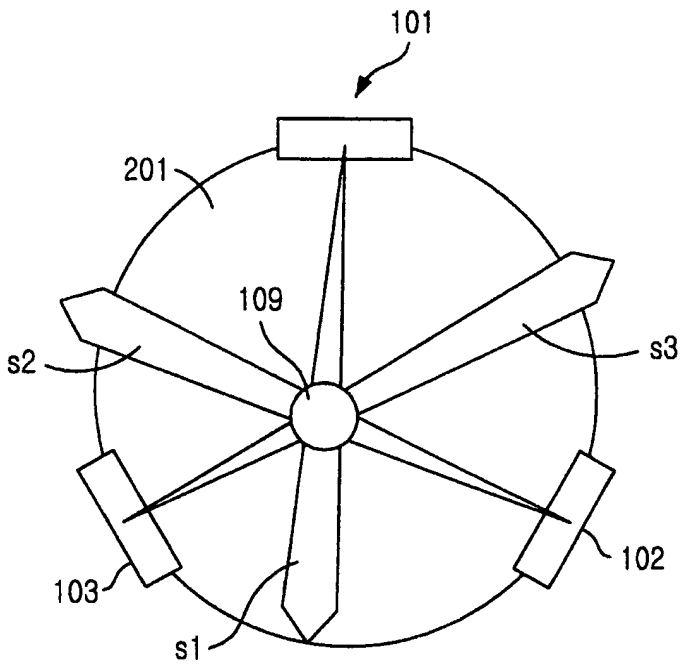


FIG. 3

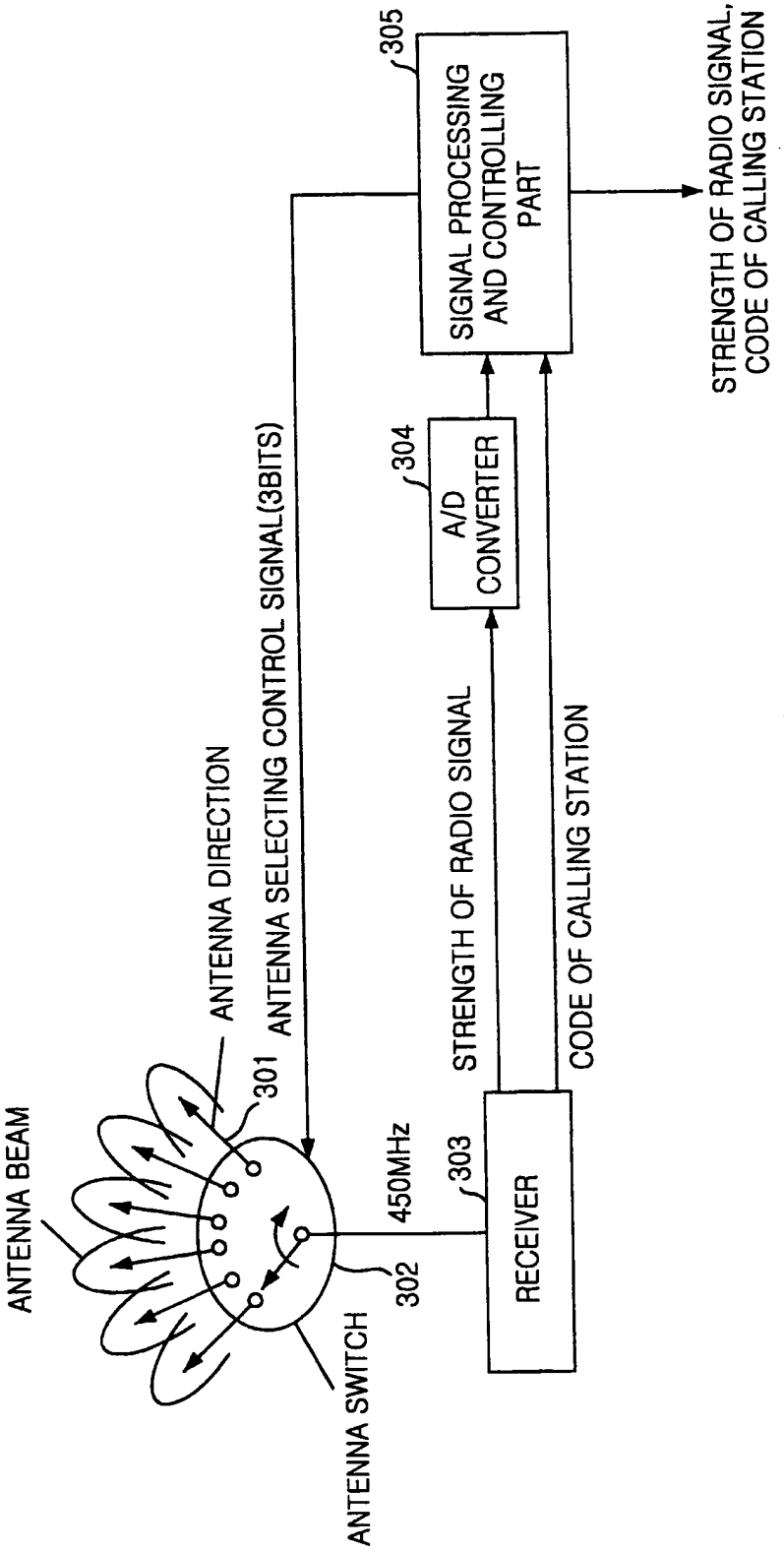

ANTENNA BEAM
ANTENNA DIRECTION
301
ANTENNA SELECTING CONTROL SIGNAL(3BITS)
ANTENNA SWITCH
302
450MHz
303
RECEIVER
STRENGTH OF RADIO SIGNAL
CODE OF CALLING STATION
304
A/D CONVERTER
305
SIGNAL PROCESSING AND CONTROLLING PART
STRENGTH OF RADIO SIGNAL, CODE OF CALLING STATION

FIG. 4

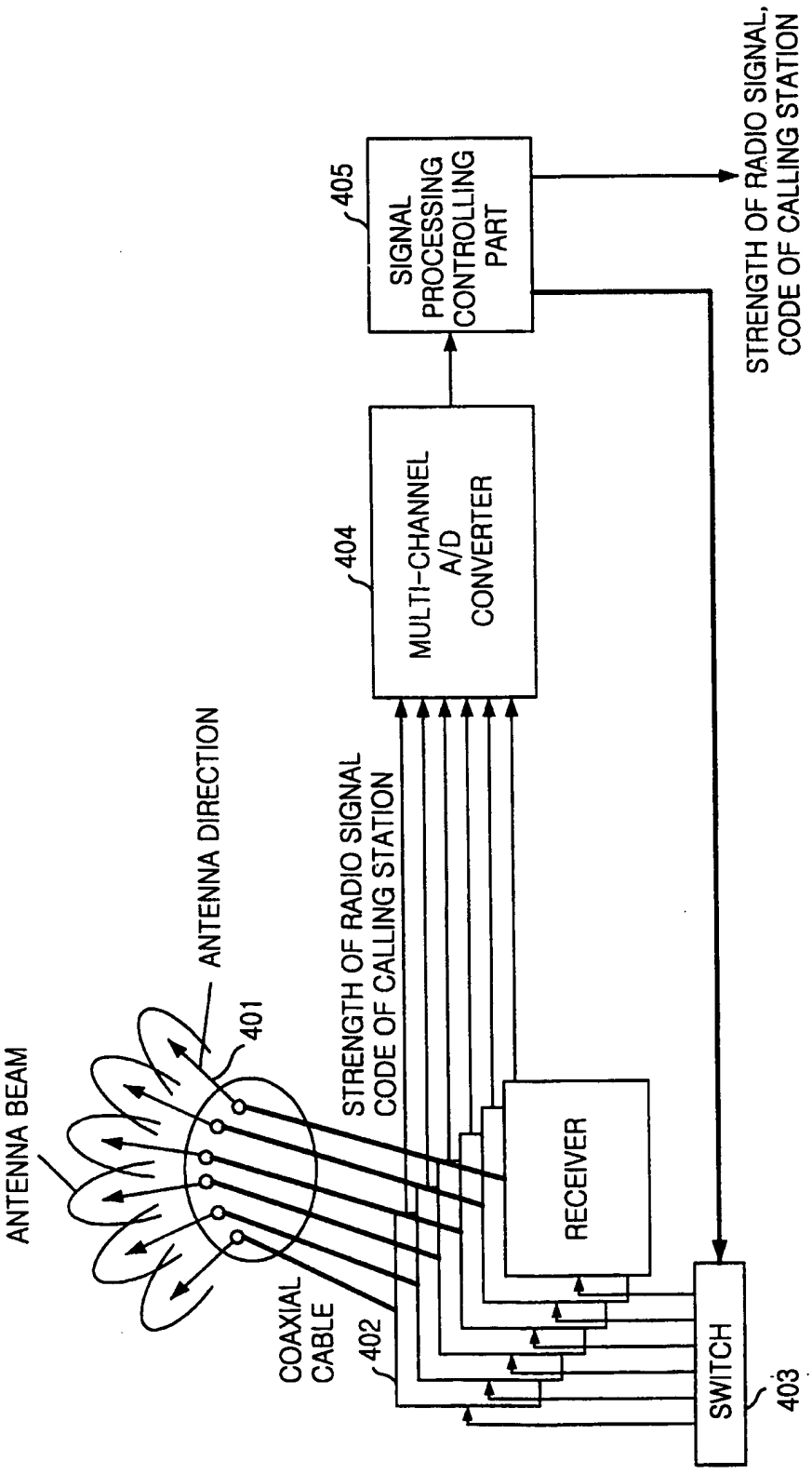

ANTENNA BEAM
ANTENNA DIRECTION
401
COAXIAL CABLE
402
STRENGTH OF RADIO SIGNAL
CODE OF CALLING STATION
RECEIVER
SWITCH
403
404
MULTI-CHANNEL A/D CONVERTER
405
SIGNAL PROCESSING CONTROLLING PART
STRENGTH OF RADIO SIGNAL,
CODE OF CALLING STATION

FIG. 5

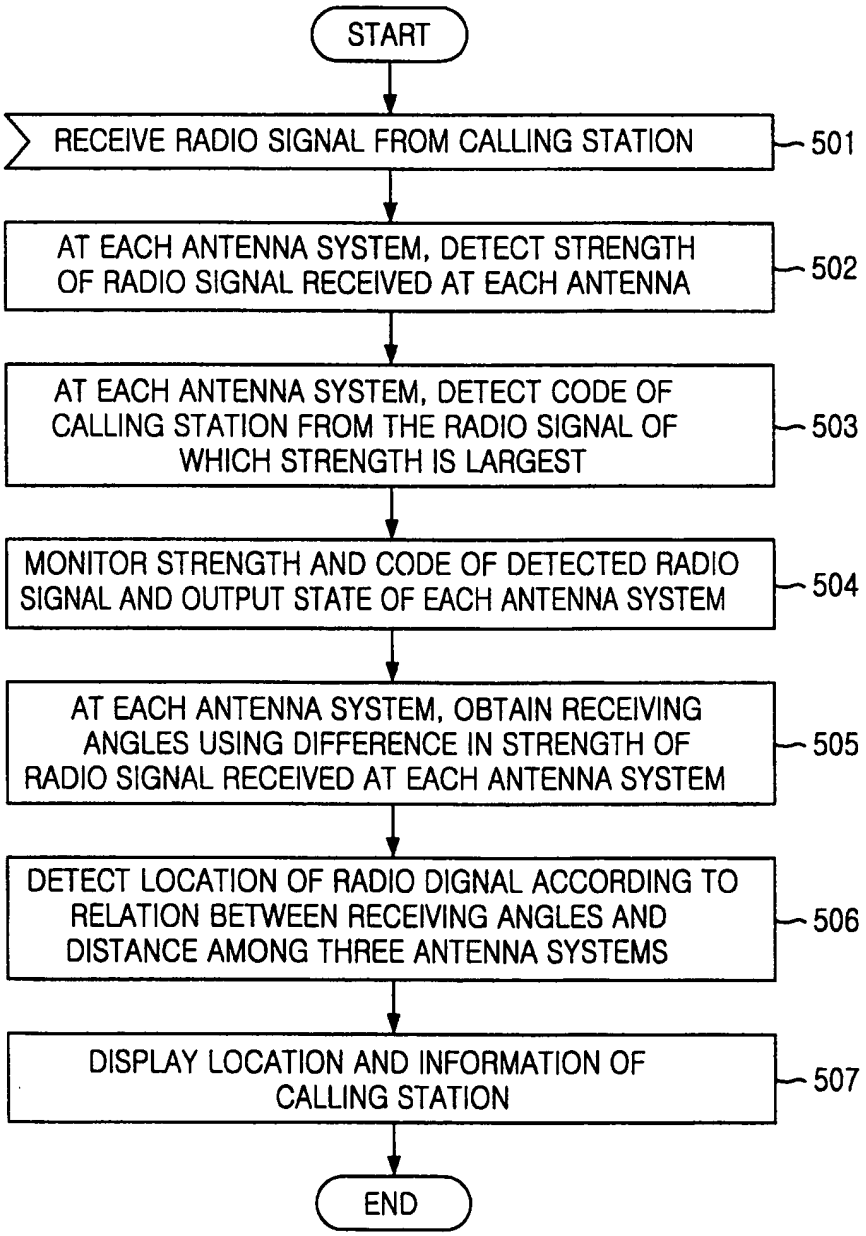

START
RECEIVE RADIO SIGNAL FROM CALLING STATION
501
AT EACH ANTENNA SYSTEM, DETECT STRENGTH OF RADIO SIGNAL RECEIVED AT EACH ANTENNA
502
AT EACH ANTENNA SYSTEM, DETECT CODE OF CALLING STATION FROM THE RADIO SIGNAL OF WHICH STRENGTH IS LARGEST
503
MONITOR STRENGTH AND CODE OF DETECTED RADIO SIGNAL AND OUTPUT STATE OF EACH ANTENNA SYSTEM
504
AT EACH ANTENNA SYSTEM, OBTAIN RECEIVING ANGLES USING DIFFERENCE IN STRENGTH OF RADIO SIGNAL RECEIVED AT EACH ANTENNA SYSTEM
505
DETECT LOCATION OF RADIO DIGNAL ACCORDING TO RELATION BETWEEN RECEIVING ANGLES AND DISTANCE AMONG THREE ANTENNA SYSTEMS
506
DISPLAY LOCATION AND INFORMATION OF CALLING STATION
507
END

FIG. 6

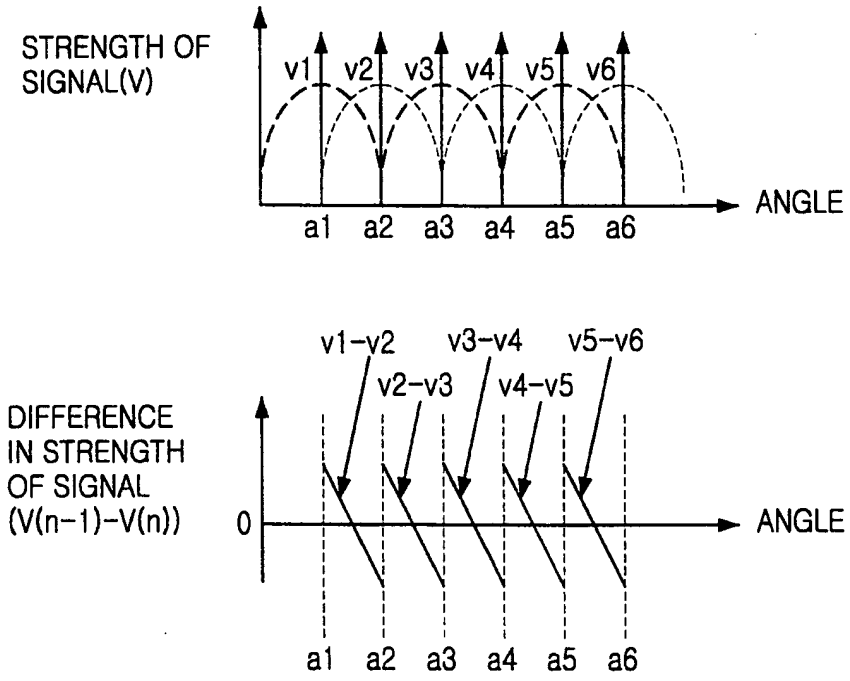

STRENGTH OF SIGNAL(V)
v1
v2
v3
v4
v5
v6
ANGLE
a1
a2
a3
a4
a5
a6
DIFFERENCE IN STRENGTH OF SIGNAL (V(n-1)-V(n))
v1-v2
v2-v3
v3-v4
v4-v5
v5-v6
0
ANGLE
a1
a2
a3
a4
a5
a6

FIG. 7

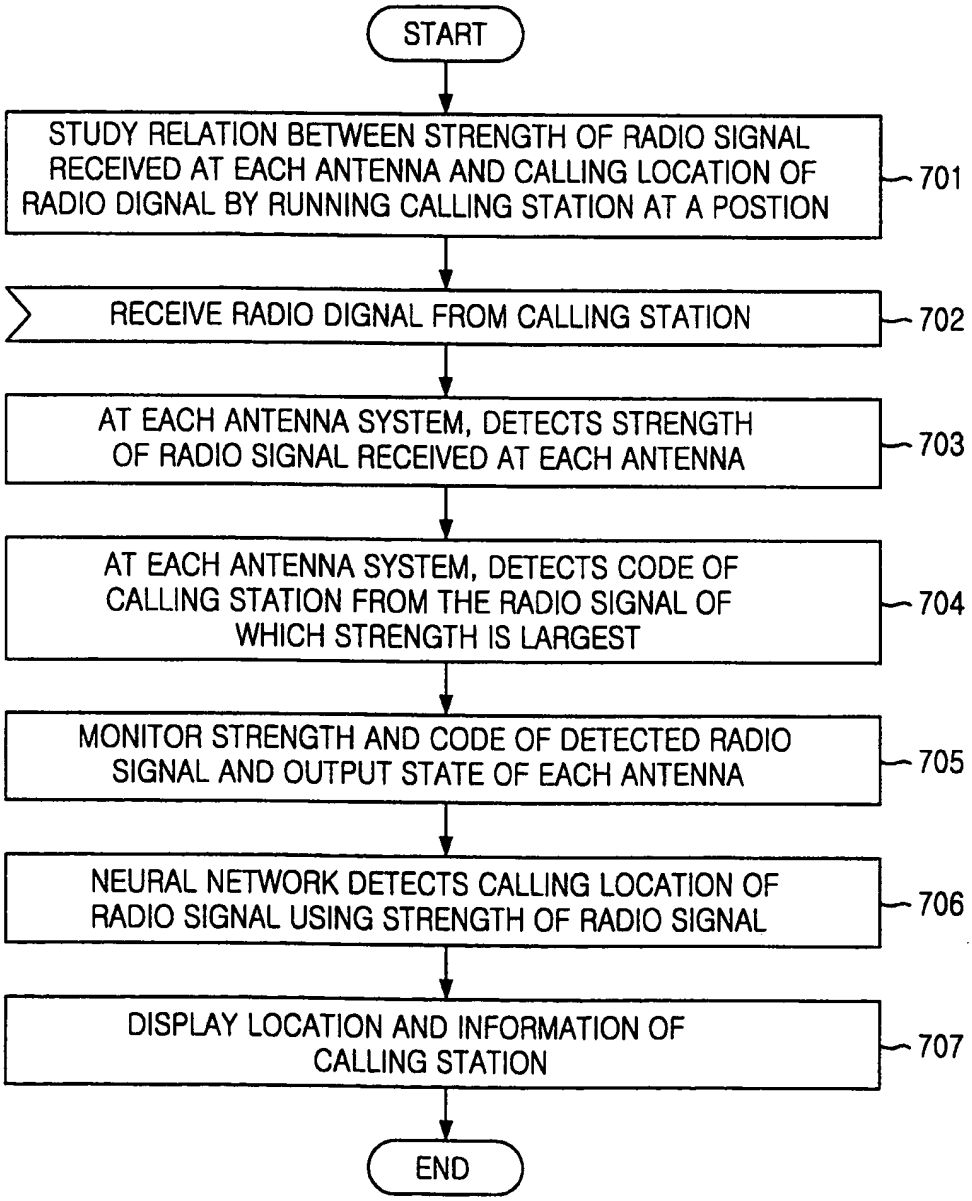
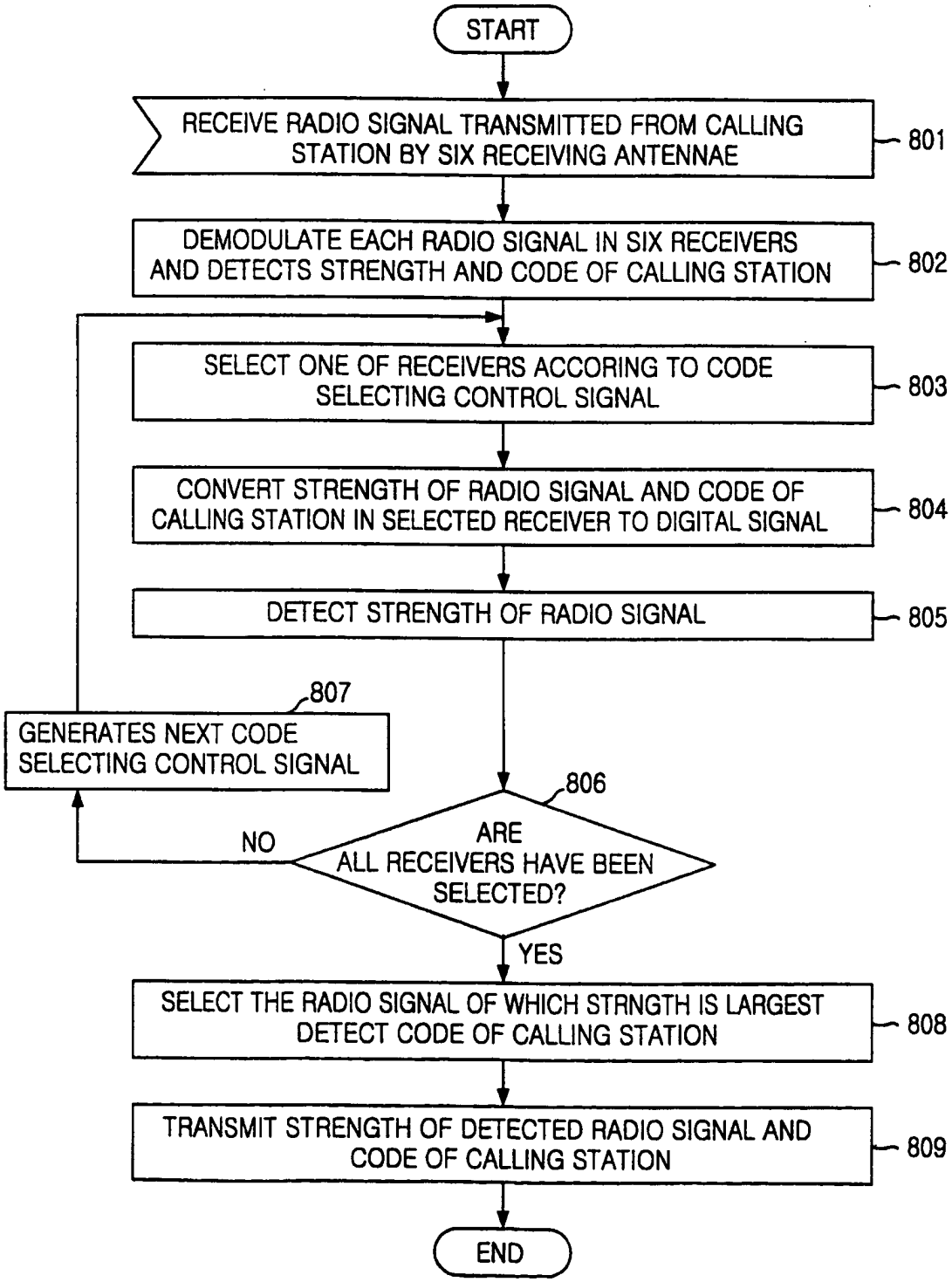

START
STUDY RELATION BETWEEN STRENGTH OF RADIO SIGNAL RECEIVED AT EACH ANTENNA AND CALLING LOCATION OF RADIO DIGNAL BY RUNNING CALLING STATION AT A POSTION
701
RECEIVE RADIO DIGNAL FROM CALLING STATION
702
AT EACH ANTENNA SYSTEM, DETECTS STRENGTH OF RADIO SIGNAL RECEIVED AT EACH ANTENNA
703
AT EACH ANTENNA SYSTEM, DETECTS CODE OF CALLING STATION FROM THE RADIO SIGNAL OF WHICH STRENGTH IS LARGEST
704
MONITOR STRENGTH AND CODE OF DETECTED RADIO SIGNAL AND OUTPUT STATE OF EACH ANTENNA
705
NEURAL NETWORK DETECTS CALLING LOCATION OF RADIO SIGNAL USING STRENGTH OF RADIO SIGNAL
706
DISPLAY LOCATION AND INFORMATION OF CALLING STATION
707
END

FIG. 8


START
RECEIVE RADIO SIGNAL TRANSMITTED FROM CALLING STATION BY SIX RECEIVING ANTENNAE
801
DEMODULATE EACH RADIO SIGNAL IN SIX RECEIVERS AND DETECTS STRENGTH AND CODE OF CALLING STATION
802
SELECT ONE OF RECEIVERS ACCORING TO CODE SELECTING CONTROL SIGNAL
803
CONVERT STRENGTH OF RADIO SIGNAL AND CODE OF CALLING STATION IN SELECTED RECEIVER TO DIGITAL SIGNAL
804
DETECT STRENGTH OF RADIO SIGNAL
805
807
GENERATES NEXT CODE SELECTING CONTROL SIGNAL
806
NO
ARE ALL RECEIVERS HAVE BEEN SELECTED?
YES
SELECT THE RADIO SIGNAL OF WHICH STRNGTH IS LARGEST DETECT CODE OF CALLING STATION
808
TRANSMIT STRENGTH OF DETECTED RADIO SIGNAL AND CODE OF CALLING STATION
809
END